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Meteorology at the Meeting of the British Association for the Advancement of Science, Leicester, 1933

The subject of meteorology played an important part in the programme of the recent meeting of the British Association for the Advancement of Science, for not only was there the usual session of the Department of Cosmical Physics of Section A (Mathematical and Physical Sciences) devoted to meteorology and geophysics, but the President of Section A itself was this year a meteorologist, Sir Gilbert Walker, C.S.I., F.R.S., and three foreign geophysicists, Prof. Franz Linke, Prof. E. Regener, and Prof. L. Vegard, attended the meeting and contributed to the discussions. In addition there were, as usual, a few papers concerning meteorology and climatology read in other Sections of the Association.

A wide variety of subjects was discussed, and some general advance of knowledge could be discerned, even if there was little indication of the generation of a "new line of thought," the absence of which is so much regretted by the Editor of the *Quarterly Journal of the Royal Meteorological Society* in a recent number of that journal.

Sir Gilbert Walker's presidential address was on seasonal weather and its prediction, a subject of great interest to the professional meteorologist, the industrialist whose activities are affected by the weather, and the "man-in-the-street." Much

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has been written on the subject and most of what has been written can be criticised, sometimes for the admixture of too much imagination with too few data, and sometimes for the absence of common sense from purely numerical arguments. Sir Gilbert struck an agreeable compromise, by cheerfully admitting the limitations of the evidence so far available, while showing that the phenomena are real and important and demand explanation. In this magazine it is perhaps unnecessary to describe in detail the nature of the relations between the abnormalities of seasonal pressure, rain, etc., in one part of the world and another, which was the main subject of the address; for much of this has appeared in the past in the technical press and the address will appear in full elsewhere. Rather, it may be of greater interest to consider how some of the salient conclusions were likely to be received by a member of the audience who had come for the first time from other fields of physics to the contemplation of this branch of meteorology. No apology is offered for doing this, for it is admittedly difficult for one engaged continuously in the study of one subject always to discern the wood from the trees, and it is possible we may gain from considering the outsider's point of view.

A physicist in the habit of measuring constants and effects to the *n*th place of decimals might be tempted to scoff at a science which deals with reactions which can only be relied on to "come off," say, 70 per cent. of the times they are tried. As has been indicated, this criticism was met by Sir Gilbert by a clear defence of the reality of correlation ratios—"statistical methods show us what quantities vary together, but strictly by themselves they tell us nothing as to causation." He might have gone on to say that it has been argued that even the simplest and most direct "causes" and "effects" of the physical world are merely events which happen to follow each other so very frequently that we have come to regard their sequence as inevitable. This perhaps is quibbling, and there is a moral to be learnt from the attitude of our hypothetical physicist—that qualitative theories which appear usually to be valid are not good enough, and greater and greater exactness must be sought. Meteorological phenomena are so complicated that some can generally be found to support almost any theory. Sir Gilbert remarked that "more than once I have seen in journals of repute the artless remark of an author that if he were to limit his results to those which would satisfy the criteria of reality he would obtain few results of interest!"

It is disconcerting to the meteorologist, and perhaps amusing to our physicist, to find that a prediction formula will yield very good results for a large number of years, at any rate as regards extreme abnormalities of an element, and then without warning suddenly go wrong. It is understandable that the meteorologist

should be reluctant to publish forecasts while this sort of thing can happen, and of course he must not rest content (and is not doing so) to leave things in such a state. While, as Sir Gilbert says, "the forecasting efforts of a charlatan are judged by their occasional successes, and it is the occasional failures of a government department which are remembered against it," it is also perhaps wise that forecasts about which there is some doubt should not be published. But the correlation ratios quoted by Sir Gilbert, which are only a sample of what have been computed, really do show that forecasts can be made with much greater accuracy than can be done by tossing a coin.

Prof. Franz Linke took as his subject "The Influence of the Stratosphere on the Development of Cyclones," and introduced a discussion on the possibility of reconciling the Norwegian and German-Austrian schools of thought with the remark, "One notices that a temperamental contest has been taking place between Norwegians on one side and Germans and Austrians on the other side; one might say that there is a Norwegian-German front. This scientific front has led to a development of latent energy, and thereby advanced the science of meteorology." Since the first enunciation of the simple Norwegian frontal theory of cyclones, which concerned the troposphere alone, our picture of the origin of nature of cyclones has tended to become more and more complicated, as indeed it must become if it is to bear semblance to reality. Much has been written on the effect of tropopause waves on the pressure and weather conditions in the troposphere, and Prof. Linke visualised a complex series of possible actions and reactions between stratosphere and troposphere which would explain the known phenomena of the formation, movement and energy exchanges of cyclones. He concluded: "On account of the progress attained on both sides, the German-Norwegian front is about to die. The conflict as to whether the stratospherical or troposphpherical occurrences are primary is based on a false question. In every level disturbances can originate whose effects extend throughout the air masses. . . . The theory of the complex cyclone is naturally a disillusion for all those meteorologists who had hoped to be able to calculate the variations of the weather by simple formulæ. That will be possible only when every single day we have reports from a great area of the Earth's surface up to great heights. Remembering the great advances in the technique of flying, we can hope that that soon will be the case."

At one of the most entertaining and instructive meetings of Section A, Prof. Linke showed a ciné film of cumulus cloud formation. Photographs of clouds were taken at intervals of from 3 to 6 seconds throughout their life, and were put through the projector at the rate of 16 per second. The events of a whole afternoon were thus condensed down into a few minutes.

It was indeed fascinating to see a cloud begin to form over a ridge of hills, to watch it grow, the whole mass "boiling" furiously, and perhaps to see a big lump detach itself and float off as an isolated "wool pack," or to see an anvil form at the top. In another part of the film, typical heat convection, "April weather," clouds were seen to form and float away with the wind. One could have wished that the film was not speeded up so much, for, although the film was repeated, some of the more interesting phases in the life-history were over before one could see clearly what was happening. This simple, but extremely convenient and dramatic method of cloud study was devised in the course of investigating the meteorological conditions necessary for successful "gliding" and "soaring" flights, and it is proposed to go on and study other cloud types in the same way. The tedium involved in watching clouds for long periods of time is no doubt partly responsible for the sparseness of experimental verification of the suggestions which have been made regarding the mode of generation and change of form of clouds; and the rapid fire of questions which followed Prof. Linke's film demonstration showed how keenly field observations are appreciated.

It may perhaps be possible to obtain further evidence by the film method for the existence in the atmosphere of the various cloud forms so ingeniously obtained in the laboratory by Sir Gilbert Walker. One of his collaborators, Mr. A. Graham, gave an account of cloud forms produced in a thermally unstable layer of air, subjected to a single mechanical shear, and subjected to no shear. The forms obtained have all been observed in the atmosphere; but if the change from one form to another when the conditions change, and the direction of motion in the centres of the cells, could be clearly demonstrated by a ciné film, it would go far towards convincing one that the patterns observed in the sky are due to thermal instability and not to Helmholtz waves.

Prof. Vegard summarized existing knowledge of auroræ, and proceeded to discuss what can be deduced from it regarding the constitution of the upper atmosphere. The spectra of auroræ have been measured at Tromsø and elsewhere from 9,000 Å., right through the visible wave-lengths, to the limit of atmospheric transmission in the ultra-violet. Apart from the green line and two red lines, the spectrum is predominantly that of nitrogen, and there is no evidence for the layers of hydrogen and helium which it has been argued must exist in the upper atmosphere. An effect has been observed in which the nitrogen bands become enhanced relative to the green line, as the altitude increases; and the temperature of the molecules emitting the auroral light has been estimated from the negative nitrogen bands. This information, together with other observations

regarding the streamers, etc., has been utilised by Prof. Vegard to build up a fairly complete picture of the constitution of the upper atmosphere. He regards it as being similar to the sun's corona, and claims that his picture fits in with radio-echo work and with Rayleigh's and Slipher's spectral observations of the zodiacal light and the luminescence of the night sky. In the time allotted to this paper it was impossible that the subject should be considered in all its detail, and confirmation of the conclusions, either experimentally using the Polar Year data, or theoretically, will be awaited with interest.

If we may be permitted to make a distinction between geophysicists and other physicists, it may be claimed that in the early days cosmic radiation was primarily the study of geophysicists, and only later has it attracted wider attention. Would that physicists could be induced to take an interest in other meteorological studies, for although few can be expected to interest "electron chasers" in the way that cosmic radiation has, there are many with both theoretical and practical aspects which should stimulate the interest of physicists in general.

Prof. P. M. S. Blackett, F.R.S., opening a discussion on the positive electron, described how this was first detected by Anderson and by Blackett and Occhialini in the course of the study of cosmic rays by the cloud method. The photographs showed the presence of positively electrified particles, the mass and magnitude of the charge of which did not differ from those of the negative electron by more than 50 per cent. These positive electrons appeared to originate in some disruptive process brought about by incident cosmic radiation. In an earlier paper Prof. E. Regener had described his latest researches in the distribution of cosmic radiation. It was fascinating to hear at first hand from the inventor about the ingenious devices incorporated in his counting apparatus. The height is measured by the pressure, which is recorded by two aneroids, one of which is of very high sensitivity and only comes into play when the instrument is so high up that the one of ordinary sensitivity is recording only very inaccurately. Perhaps the neatest feature of the apparatus was the cellophane covering, which maintained the temperature up to or above the ground value at 30 Km. height. The action of the covering was the same as that which is supposed, but, according to Wood, does not, occur in a greenhouse.

The condensation of water plays such an important part in so many atmospheric phenomena that it is remarkable that we are still in comparative ignorance as to its mechanism. Some aspects of the problem were discussed at a meeting of the Department of Cosmical Physics, under the chairmanship of Prof. J. J. Nolan. It was evident from a number of the papers that experimental difficulties in the way of the investigation of this

subject are largely responsible for our ignorance. For example, Dr. G. C. Simpson believes that the appearance of maxima and minima in the frequency curves of cloud particle and rain-drop sizes found by several investigators is not due to the existence of groups of drop sizes in a regular series; but is due to some experimental error connected, perhaps, with the method of measurement of the drops.

Experimental difficulties were also referred to by Mr. H. L. Green, in a discussion of the methods that have been invented for measuring the number and sizes of particles in the atmosphere. He stressed the limited applicability of most of the methods, and remarked: "In a recent comprehensive account of methods for estimating dusts in industry, Professor Heymann, of the University of Berlin, refers to some seventy papers containing descriptions of sampling instruments. Unfortunately, although there is a wealth of instruments which are portable and easy to manipulate, it is difficult to find any that is really efficient in precipitating the particles of the aerosol in a state for effective examination. Workers have hitherto been handicapped by the absence of means for testing the efficiencies of their instruments, but with the advent of the ultra-microscope and sedimentation methods, this difficulty should disappear." Finally, Mr. L. H. G. Dines reported that "it is found that in about half of all the soundings (of the upper atmosphere, using meteorographs fitted with hair hygrometers) at some stage of the flight, the hair expands to a length greater than that corresponding with immersion in water or an ordinary artificial fog. . . . At first when this phenomena was noticed the writer supposed it to have little significance, and thought that probably it only represented the measure of his ignorance of the precise response of hairs to changing conditions of relative humidity. As time went on this explanation grew less tenable, and the conviction grew that there must be some physical condition present in many clouds which was not present in the ordinary artificial fog." The true interpretation of the hair hygrometer record when it shows an apparent super-saturation is still, however, a matter of speculation.

Prof. Nolan described some experiments made to test, amongst other things, whether the low mobility ions required by Wilson's theory of thunderstorm electrification are directly produced by discharge from rain-drops when subjected to the intense electric fields which obtain in thunder clouds. He found that no such ions are formed in clean air, even if the field is so intense that the drop is broken up, and that therefore some other explanation must be sought.

Mr. A. C. Best reported a series of two years' measurements of the temperature differences over the height intervals of 2.5 to 30 cm. and 30 cm. to 120 cm. over grass. Such measure-

ments as these are of first-class importance, for not only is the number available small, but also they are fundamental in all work dealing with stability and turbulence in the atmosphere. The main conclusions of the work were summarised by Mr. Best in a series of graphs and tables; but it is to be hoped that he will make the complete results available to the meteorological public in due course.

Climatology was this year left to the consideration of Section E—Geography. Prof. L. L. Rodwell Jones and Mr. F. H. W. Green dealt with the wind and rainfall of Kenya and Uganda. Naturally there are few data for some parts of these countries, but even so the effect of the major topographical features can be discerned. For instance, the eastern highlands form a definite rain "shadow"; and the northern rift separates one type of distribution from another in the same latitude. As regards wind, land and sea breezes are very prominent on the northern verge of Lake Victoria, and may at times deflect the normal monsoon directions at Zanzibar. In this section also there was a paper by Prof. C. Daryll Forde on "Variations in the native economy of arid regions," wherein he showed that climatic divisions into "hot" and "continental" deserts and gradations from winter to summer precipitation appear to be largely irrelevant to the classification of native economics, physiographic and biological conditions and cultural history being far more important.

Seismology was represented by two papers in the Department of Cosmical Physics (Section A†) meeting on September 12th. In the first, Mr. T. Tillotson argued that a wrong identification of one of the series of seismic waves arriving at an observatory has in some cases led to an incorrect conclusion as to the depth of focus of the earthquake. English earthquakes, although generally mild in intensity, are naturally of peculiar interest to an English audience, and the Association welcomed an account from Father J. P. Rowland, S.J., of his attempts to trace the source of an earthquake which disturbed the northern part of England on January 14th of this year. From the reports received from various parts of the country as to the intensity of the shock felt, it was possible to draw iso-seismal curves which centred roughly on north-west Yorkshire. More accurately timed data from a number of seismological observatories limited the area in which the focus probably lay to a small triangle near Hawes, wherein a fault is shown in the geological survey map. The data are not accurate enough to prove conclusively that the earthquake was associated with this fault, and not one of a number of others which lie fairly near, but Father Rowland considered there was little doubt that the source was somewhere in Wensley Dale.

M. G. BENNETT.

The Amateur Meteorologist

Prof. J. Fairgrieve delivered an address before the Conference of Corresponding Scientific Societies entitled "The Amateur Meteorologist," in which he pointed out a number of ways in which amateurs could assist the science of meteorology. First came observations, especially of rainfall, wind and sunshine, by the establishment of instruments in places from which the information was at present insufficient. Another interesting subject for the amateur is the checking of weather forecasts as applied to his own locality, and there is also phenology, in which help will be warmly welcomed by the Royal Meteorological Society. From these individual examples he went on to what he considered the main characteristic of amateur work, namely, dealing with problems of large numbers of amateur and sometimes intermittent observations, while the province of the professional is more to deal exhaustively with a few accurate and continuous records. Thus an amateur can collect reports from the public and study the development and passage of a heavy thunderstorm or a fog, and the lecturer illustrated this aspect by reference to some amateur studies which he had himself carried out. Work of this kind is of value in encouraging the habit of observation in the public. Finally, he referred to the series of articles on "Problems of Meteorology" in the *Quarterly Journal*, and suggested that the amateur could tackle these physical and mathematical problems equally with the professional. Altogether, there is a great deal of scope for the amateur meteorologist.

Sunspots and Sunshine

The dates 1899, 1911 and 1921 given by Mr. J. B. C. Kershaw on p. 207 of the October issue of this magazine for the last three minima of the sunspot cycle are at variance with those officially accepted, which are 1901, 1913 and 1923. It is hardly probable, moreover, that 1933 will, as Mr. Kershaw anticipates, prove to be the year of the next minimum; during the past ten months there has at times been very considerable solar activity, in particular from January to March, when the spot-groups were on several occasions large enough to be seen through mist without telescopic aid.

Mr. Kershaw's contention that years of sunspot minimum are years of abundant sunshine in England must thus be regarded as negated by his own diagrams, which indicate that 1913 was markedly deficient in this respect, and that 1923 was sub-normal at a majority of the stations chosen for his investigation. (The Annual Summary of the *Monthly Weather Report* stigmatised 1923 as "a dull and wet year.") Furthermore, 1889, the last

spot-minimum year of the nineteenth century, has never since been equalled for sunlessness at Kew Observatory.

We have good evidence, however, that south-east England has, for some time past, experienced a bright and notably warm summer late in the declining phase of each sunspot cycle—usually about two years in advance of the minimum. The meteorological statistics at Greenwich Observatory show this to have occurred regularly back to 1876, when registration of sunshine was begun there. Since then the years of sunspot minimum have been* 1878, 1889, 1901, 1913 and 1923. That the summers of 1876, 1887, 1899, 1911 and 1921 in this part of the country were all characterised by high temperature, and five of them, at least, by pronounced excess of sunshine, is demonstrated by the following abstracts from the Royal Observatory records. (Corresponding figures for 1933 are added for purposes of comparison.)

GREENWICH OBSERVATORY—JUNE TO AUGUST.

Year.	TEMPERATURE.			SUNSHINE.	
	$\frac{1}{2}$ (Mean Maximum + mean Minimum).	Difference from Normal, 1841-1932.	Number of days with Maximum at or above 80° F. (Normal = 13.)	Total.	Difference from Normal, 1881-1915.
	°F.	°F.	Days.	Hrs.	Hrs.
1876	64.2	+2.0	28	616	+21
1887	64.2	+2.0	27	715	+126
1899	64.7	+2.5	20	756	+161
1911	65.9	+3.7	37	819	+224
1921	64.2	+2.0	22	686	+91
1933	65.6	+3.4	31	698	+103

There is reason to believe that the sunshine values given for 1876 and 1887 may be substantially too low; by the middle of the "nineties" the sphere of the recorder had deteriorated in such a manner as to involve serious loss of trace, and comparable statistics are not considered to have become available until 1897, when a new sphere was taken into use.

In the absence of any quantitative data for sunshine prior to 1876, the full comparison cannot be extended further back. We may note, however, that the sunspot minima of 1867, 1856 and 1843 were each preceded at intervals of one to three years by summers which were described in contemporary literature as "fine and bright," and which records show to have been decidedly drier than usual. The period from June to August in 1864 was marked by acute drought, England and Wales as a whole receiving only 50 per cent. of the normal rainfall during the three months, according to the data published on pp. 300-5 of *British Rainfall*, 1931. From the same source it may be

* See *Meteorological Glossary*, 2nd Edn., p. 168.

ascertained that the June—August precipitation was 15 per cent. below normal in 1854, and 10 per cent. below normal in 1842. Of the three summers just mentioned, only that of 1842 was particularly warm at Greenwich, on the basis of mean temperature; each of them gave approximately the average number (13) of days with maxima in the "eighties," there being 15 of these in 1864, 11 in 1854, and 17 in 1842.

The whole matter is one for future investigation; at present our records do not cover a long enough period to enable definite conclusions to be drawn. Meteorologists are well aware how far the arm of coincidence can reach, and few of them are likely to dispute that the association of outstandingly well-behaved summers with the near approach of six consecutive minima of the sunspot cycle might conceivably come within its comprehensive span. Nevertheless, it is tempting to assume that the connexion is a real one, and that the memorable summer of 1933 is somehow linked up with the solar processes conducing to a sunspot minimum in 1934 or 1935.

It is to be feared that even if such a relationship can eventually be proved, it will give us no great help in solving the problems of seasonal forecasting, since the phases of the sunspot cycle are inconstant and, in the light of existing knowledge, unpredictable. The famous 11-year (or 11·25-year) "period" is merely the average length of the interval between successive peaks of solar activity. How this may vary can be judged from a study of Wolf and Wolfer's tables, which show that there were maxima in 1830 and 1837, but none from 1787 to 1804; a maximum may be separated from the ensuing minimum by as many as 11 years (*e.g.*, 1787-1798), or by as few as three years (*e.g.*, 1830-1833).

A recent investigation by W. B. Schostakowitsch, of the Soviet Meteorological Service, into sunspot relationships with different meteorological elements over the various continents and oceans has led him to the conviction that markedly more precipitation falls over the earth as a whole at times of spot maximum than at times of spot minimum. If this is so, it seems quite logical to infer a decrease of cloudiness, and consequently an increase of sunshine, at the latter epoch, though so far as England is concerned it is evidently not the actual years of spot minimum that give most insolation.

Should it ever be shown that southern England does regularly experience a particularly bright and warm summer at an interval ranging from one year to three years before the minimum of solar activity, this varying period of separation between the two phenomena might perhaps be explained on the assumption that the actual position of the spotted area is involved in the connexion. It is known that with the advance of each pulse in the solar cycle there is (or has been as far back as the middle of last century) a fairly steady decrease in the mean latitude of

the spots. Two years before minimum it is normally the zones from 6° to 9° north and south of the sun's equator that are chiefly affected, but these limits are subject to fluctuation, and the penultimate year of one cycle may be characterised by the same mean spot-latitude as the ante-penultimate year of the next cycle. Since both auroræ and magnetic storms are believed to originate in emanations from restricted areas of the solar envelope, it does not seem unreasonable to suppose that, through some unknown train of events, southern England's summer weather may be favourably influenced by a concentration of activity within 6° to 9° on either side of the solar equator.

In view of Mr. Kershaw's belief that a three-and-a-half or four years periodicity can be traced in the sunshine records for English stations, it may be worth while recalling that in 1907 W. J. S. Lockyer detected a cycle of approximately 3.75 years for solar prominences.

E. L. HAWKE.

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings will be:—
November 27th, 1933.—*The maintenance of the earth's electric charge.* By E. Schweidler (Probleme der kosmischen Physik XV, Hamburg, 1932) (in German). *Opener*—Dr. H. Spencer Jones.

December 11th, 1933.—*Sounding balloon ascents at Abisko from 1921 to 1929.* By B. Rolf (Stockholm, Medd. Meteor. Hydr. Anst. Vol. 5, No. 5, 1932) (in French). *Opener*—Major A. H. R. Goldie, M.A.

Correspondence

To the Editor, *The Meteorological Magazine.*

A Meteor Shower

Last night, October 9th, 1933, a most amazing "meteor shower" was observed at Eskdalemuir. I think it worth while forwarding you a description, as practically the whole of England and the extreme east of Scotland were under a thick cloud sheet, so that the phenomenon would probably not be observed in these parts. As regards the British Isles as a whole, it would probably have been observed in Ireland and western Scotland. It may just possibly have been seen at Edinburgh.

The shower was first observed at 19h. 45m. G.M.T. by Messrs. W. I. Jones and W. A. C. Webb, who drew my attention to it, and we watched it for a considerable time. The sky to the south and east (nearly to the zenith) was covered with nimbus and alto-stratus cloud, the latter presenting a definite edge. The alto-stratus was associated with a "cold front" which had

passed Eskdalemuir at 17h. 30m. Detached cumulus cloud was visible low down in the west, but between the two banks of cloud the sky was clear. The alto-stratus was slowly retreating eastwards.

Literally thousand of meteors, some very bright, were observed between 19h. 45m. and 20h. 30m. They were observed at practically all parts of the visible sky, and their paths, if produced backwards, seemed to radiate from an area in the sky in the constellation of Draco near Beta Draconis. The tracks of the meteors were mostly not very long and appeared at all parts of the sky to within about 10° - 15° of the horizon.

The meteors were most numerous and bright during the first half of the period quoted above, thereafter decreasing in frequency and in the number of bright meteors. By 20h. 30m. a sheet of cumulus had spread up from the south-west and covered the sky. Thereafter there were partial clearances and occasional meteors could be seen. At 21h. 10m. the sky cleared considerably and from then until 22h. 15m. occasional meteors were seen. One or two of these latter ones did not appear to radiate from the area in the constellation of Draco.

L. DODS.

The Observatory, Eskdalemuir, Langholm. October 10th, 1933.

[Meteors were also reported on the same day from the whole of Europe (from Ireland and Portugal to Russia), the Mediterranean and the Gold Coast in $5\frac{1}{2}^{\circ}$ N. The meteors were not especially bright but attracted attention by their numbers; according to Mr. R. Forbes-Bentley at Malta they numbered about 22,500. They left yellowish trails. Mr. A. King in *Nature* defines the radiant point on the mean of four observations (Eskdalemuir, Armagh, Omagh and Malta) as having an azimuth of 264.5° and an elevation of 54.5° . At Agona Swedru Mr. L. J. Packham described the direction of motion as from north to south.

Mr. C. P. dos Santos, Lloyd's Agent at Faro, Portugal, writes that at Faro "the shooting stars irradiated from a fixed spot in the sky, somewhat situated in the midst of the constellation of Ursa Minor, the stars following the trajectories of north—south, north—south-east, north—south-west. The phenomenon here in Faro practically lasted from 8 p.m. to 10 p.m., the brilliancy of the shooting stars not being very great, and it was ensued by a thick white fog, spreading all over the sky."—*Ed., M.M.*]

The Summer of 1933 at Newquay

As we have been enjoying an excellent summer it will be interesting to see how it compares with previous good ones. For purposes of comparison I take summer to be the four months June to September.

We will commence with a table giving the main statistics for fine summers.

	Mean Max.	Mean Min.	Rainfall.	Rain days.	Sunshine.
	°F.	°F.	in.	No.	hrs.
1898	64.8	55.3	5.05	38	655
1899	67.0	56.8	7.50	43	945
1911	67.7	54.9	7.91	42	1,028
1921	66.3	55.1	6.09	38	878
1926	65.1	55.4	7.83	47	756
1933	66.4	55.4	8.46	53	853

In our climate (which we do not appreciate as we should) there is no such thing as weather repeating itself. So we find the good summers vary considerably and that no two are alike. 1899 and 1911 are distinctly the best. 1887, the first jubilee year, was perhaps even better; but local data are not available. 1898 was very dry, but comparatively cool and with a lack of sunshine. 1921 was very considerably helped by a very dry and sunny June and a very hot July. 1933 compares fairly well with 1926.

The characteristics of this summer have been its evenness, no month having been very hot or dry or sunny, and that the rainfall has been in five distinct spells, doing, I imagine, the greatest good and least harm for the amount of rain. For the gardens the rainfall has been almost perfect and their produce has been plentiful and of excellent quality and the various crops spread over a considerable period. The early farmer was not pleased with the rainfall in August; but he was compensated by the drought from August 29th to September 16th, which also enabled the "afternoon farmer" to finish harvest almost neck and neck with him.

The holiday maker seems to have been perfectly satisfied and many have prolonged their stay on account of the good weather. I did not notice many sun-blistered arms; perhaps the much talked about and boosted ultra-violet rays were less virulent than in some other summers. There were very many warm, but very few really hot days and few cool days.

Another point was the absence of any strong winds to damage the crops. The only complaint I have heard is that a drop more rain in September would have been good for the "roots."

I have been asked what is the probability of this good summer being followed by a hard winter and a poor summer next year. My reply has been that I may be a fool, and probably am; but I am not a long-period weather prophet.

C. C. VIGURS.

Marcus Hill, Newquay. October 23rd, 1933.

The Hot Summer and the Scottish Snowbeds

Papers on the permanent (!) Scottish snowbeds appeared in this magazine, Vol. 40, 1905, and in the *Geographical Journal*, Vol. 27, May, 1906, the former by the writer of this note, and the latter by the late V. H. Gatty. The articles dealt with the snowbed in the Observatory Gully of Ben Nevis which had never been known to melt. A similar snowbed exists in the Cairngorms in the Garbh Choire of Braeriach, where snow has never in living memory been known to be absent.

It seemed to me that the hot summer coupled with a low snowfall last winter in the Highlands warranted a careful investigation this autumn of these snowbeds. Though unable to go north myself I have ascertained from kindly Scottish correspondents that the Garbh Choire snowbed under Braeriach was still in existence on September 17th but had completely gone by October 1st, for the first time in memory. With regard to the Ben Nevis district information about the snowbed in the Observatory Gully is conflicting. On September 22nd, however, there was still a small patch of snow remaining under Aonach Beag (4,060 ft.), which I had noted some 16 years ago and photographed from above, and at the time had thought it looked as large or larger than the Ben Nevis bed. This was probably the case. Whether it entirely melted I have not been able to find out, but if it did disappear there could hardly have been more than a fortnight before fresh snow would have covered it.

Thus the Braeriach snowfield of the Cairngorms can no longer be regarded as permanent although it may quite likely disappear only once in fifty years.

R. P. DANSEY.

Kentchurch Rectory, Hereford. October 25th, 1933.

Spells of Sunshine

I thank Mr. Bilham and Mr. Carter for their response to my letter on the above subject which appeared in the April *Magazine*. With Mr. Bilham I agree as to the use of the word spell instead of period, and with Mr. Carter in substituting 29 for 30 days.

When I suggested the spells I had in mind simple definitions which would be applicable to the whole country just as the various definitions for rainfall are uniform throughout. The definitions now suggested vary for every station in the country and are complicated. Each station has a different "maximum possible" which is the basis of the scheme as now amended. Such would involve considerable labour, and can be done in two ways (a) by graphical method, and (b) by the preparation of tables for each station.

(a) The graph would show the curve of the "quarter

possible," "half possible" and the normal and each day's sunshine, and would have to be plotted down.

(b) A table for each station would be prepared from a graph and would show for each day "possible," "half possible," "quarter possible" and normal. Thereafter each day would be classified.

To the trained mind this is not an objection, but if classification is to be adopted generally it may have to be carried out by observers who have not the experience to follow such a method.

During my leisure, which is not extensive, I propose to investigate the scheme as it now stands amended by Mr. Carter, and later will supply a note of my results which will cover a period of fully 30 years.

WILLIAM DUNBAR.

17, Kay Park, Kilmarnock. October 30th, 1933.

Rainbow preceding Waterspout

I notice in Mr. J. Crichton's article on a "Waterspout in Kirkwall Bay" in last October's issue of the *Meteorological Magazine* there is mention of a circular or halo rainbow preceding the waterspout. I should like to mention that there was a similar occurrence at Eastbourne following soon after the passage of a roll cloud described in last June's *Meteorological Magazine*. This rainbow was low down in the sky close to the horizon out at sea and resembled a coloured spot-light and the diameter was about twice the size of a full moon when seen overhead.

J. MONGER.

17, St. James' Mansions, London, N.10. October 26th, 1933.

NOTES AND QUERIES

Memorial to Buys Ballot

A Committee has been formed in Kloetinge (Holland) for the purpose of erecting a Memorial to Buys Ballot, who was born in the year 1817, and who was one of the first pioneers in meteorology.

As Buys Ballot's reputation is world wide, it has been suggested that many of his admirers would like to contribute towards the erection of the memorial. It is proposed to erect the memorial at Kloetinge, being his birthplace.

All subscriptions should be sent to C. Kousemaker, Secretary, Comité Gedenktreen "Buys Ballot," Kloetinge, Holland.

Agricultural Meteorological Conference, 1933

After the lapse of a year in consequence of the economic crisis the series of annual conferences of workers in Agricultural Meteorology was resumed on October 6th, when a well-attended meeting was held in the Meteorological Office, South Kensington.

The conferences are organised by the Ministry of Agriculture and Fisheries in connexion with the "Crop-weather" scheme inaugurated in 1923.

In a paper entitled "The Growers' Year Book," Sir Napier Shaw expressed the view that agricultural meteorologists are greatly hampered by having to refer their data to the arbitrary and inappropriate divisions of the Gregorian calendar, and proceeded to outline a scheme for dividing the year into four quarters centering at the solstices and equinoxes. Each quarter would comprise thirteen weeks beginning on fixed dates, grouped into "chapters" of four or five weeks. The year would be regarded as beginning on November 6th, and it was further proposed that the weekly values of rainfall, sunshine and accumulated temperature should be integrated week by week from that date. Sir Thomas Middleton spoke in support of the scheme.

Prof. H. V. Blackman read a paper on "Some Effects of Temperature on the Growth of Plants," in which he gave some interesting examples of the effects of temperature changes on the growth of cereals and on the flowering of orchids and other plants.

Dr. R. A. Fisher dealt with the subject of "Sampling Observations," with special reference to the Ministry's scheme for precision observations on the wheat crop. The question of sampling is of great importance in any series of observations of this character, and Dr. Fisher's lucid exposition was followed with much interest.

In the absence of the author, copies of Mr. W. Herrod-Hempsall's paper on "The Weather and Bees" were circulated. The direct and indirect effects of weather on bees are interesting and important, as may be illustrated by the following quotation:—"The effect to the farmer, through the operation of adverse weather conditions on the bumble bee, may be appreciated when it is realised that this bee is practically the sole agent responsible for the pollination of the red clover. A paucity of bumble bees means meagre crops of red clover seed." It would be difficult to imagine a better illustration of the complexities involved in the problem of the relation between the weather and the crops.

The Conference was preceded by an instructional course, which was attended by more than twenty observers from crop-weather stations.

E. G. BILHAM.

Reviews

Meteorology for Masters and Mates. By Charles H. Brown.

As the title indicates, this book has been written primarily

for officers of the Merchant Navy, and it aims at providing all the information required to answer the questions on Meteorology set in the Board of Trade examinations, the syllabus of which is given at the beginning of the book.

The first chapter deals with the physical properties of the atmosphere, and especially refers to heat and the transmission of heat. It only touches very briefly on these fundamentals of weather, and it is considered the value of the book would have been enhanced had this section been treated at greater length.

The meteorological instruments used in ships are described in some detail in Chapter II, the descriptions being accompanied by excellent illustrations (except that of the thermometer screen, which shows a screen of the old fixed type instead of the modern portable screen); the hints on the exposure and handling of instruments given in this chapter should be particularly useful.

The following chapters deal successively with pressure and winds, cloud types and weather, tropical storms, ocean currents, optical phenomena, and organised Meteorology and the book concludes with a glossary of meteorological terms. Questions upon the subject matter included at the end of each chapter and a selection of examination questions given at the end of the book will assist the student in preparing for his examination. It is doubtful, however, whether an officer will derive any very definite ideas upon the actual physical processes of weather from a perusal of this book. These processes, a working knowledge of which is essential for any officer if he is to understand and appreciate the meteorological significance of the various phenomena encountered at sea, are only superficially dealt with. It is rather surprising, too, to find no reference to the modern conception of air masses and fronts, which are of considerable assistance in practical forecasting. The omission is doubtless due to the fact, also somewhat surprising, that no mention of these conceptions is made in the syllabus of the Board of Trade examination, but it serves to illustrate the inherent disadvantages of a text-book prepared to enable an officer to pass examinations rather than to give him a sound grounding for practising Meteorology at sea.

The book is very attractively printed and produced with ample illustrations, and fulfils its main object of covering the ground for the Board of Trade examinations.

L. G. GARBETT.

Books Received

Bulletin de l'Observatoire de Talence (Gironde). (Mensuel).

Nos. 1-12, 1932.

Anales del Observatorio Nacional de San Bartolomé en los Andes Colombianos. Observaciones meteorológicas de 1930.

Bogotá, 1932.

Royal Alfred Observatory, Mauritius. Results of magnetical and meteorological observations for July to December and Year 1931, and January to August, 1932; Port Louis 1931, 1932 and 1933.

Obituary

Sir Alexander Houston, K.B.E., C.V.O., M.B., D.Sc., LL.D., F.R.S.—We regret to learn of the death of Sir Alexander Houston on October 29th last, at the age of 68. Sir Alexander had been Director of Water Examination of the Metropolitan Water Board since 1905 and the chemical and bacteriological examinations carried out by this department have played no small part in securing the health of the vast population supplied with water by the Board. His annual reports, which made such pleasant reading (see reviews in earlier numbers of this magazine, Vol. 66, 1931, pp. 192-3, and Vol. 63, 1928, pp. 193-4), revealed his interest in meteorology.

We regret to learn of the death on August 18th, 1933, at the age of 77 years of Dr. Hemmo Bos of Wageningen, founder and editor of the international journal *Acta Phanologica*, and initiator with his brother, P. R. Bos, of the Dutch phenological network in 1894.

We regret to learn of the death in an accident on July 27th, at the age of 52, of Frank W. Peek, one of the world's foremost electrical engineers and an authority on the effects of lightning. His death interrupted preparations for an exhaustive study of electrical disturbances over New York by means of a series of lightning meters on the tower of the Empire State Building.

News in Brief

On October 9th, Sir Henry Lyons, F.R.S., retired from the office of Director of the Science Museum, which he has held since 1920. The occasion was marked by a ceremony on October 11th at which Lord Irwin, President of the Board of Education, presented a writing table, and an address was read by Sir Richard Glazebrook expressing the appreciation and admiration of the Advisory Council of the Science Museum for the work which Sir Henry has done in making the Museum a foremost place among institutions of its kind.

Professor Sydney Chapman, professor of mathematics in the Imperial College of Science, will deliver a lecture (open to the public) on "The Sun's Magnetism" before the Institution of Professional Civil Servants at the Royal Society of Arts, John Street, Adelphi, London, W.C.2, on November 24th, at 5.30 p.m.

The Weather of October, 1933

Pressure was above normal from Alaska, Canada and north-east United States across the North Atlantic, South Greenland, Iceland, north-west British Isles and central Scandinavia to Russia, western Siberia, south-east Europe and most of the Mediterranean, the greatest excesses being 8.5 mb. at 50° N. 50° W. and 5.6 mb. at Ekaterinburg. Pressure was below normal over the rest of the United States, Bermuda, the Azores, Madeira and from Portugal to Denmark, and over northern Scandinavia, Spitsbergen and between the Black Sea and the Caspian Sea, the greatest deficit being 3.7 mb. at Madeira. Temperature was above normal over western Europe and rainfall variable—in western Svealand and southern and eastern Gothaland 50 per cent. above normal.

The weather of October over the British Isles was mild and unsettled during the first fortnight, with some unusually high minimum temperatures and stormy and cold during the last week. From the 1st to the 6th a high-pressure area was situated over the country, giving mainly cloudy weather with slight local drizzle, and in the mornings and evenings much mist or fog (except in Ireland). Much sun was experienced on the southern coast from the 4th to 6th, 10.5 hrs. bright sunshine being recorded at Calshot and Weymouth on the 4th. On the 6th the high-pressure area gave way to two depressions, temperature rose somewhat, reaching 70° F. at Huddersfield and Greenwich on the 6th, while minimum temperatures in the screen did not fall below 61° F. at Brighton and Eastbourne on the 8th. Rain fell generally, becoming heavy locally on the 7th, when 2.25 in. occurred at Treacastle (Brecon). From the 9th to 11th a deep depression moved north-eastwards along our western seaboard, giving strong winds to gales mainly between S. and W. on the coasts and heavy rain generally: 3.85 in. fell at Llyn Fawr (Glamorgan) and 3.04 in. at Treacastle (Brecon). Minimum temperatures were high during this time, 62° F. being recorded at Worthing, Brighton and Eastbourne on the 10th. Thunderstorms occurred at Gorleston and Rhayader on the 8th, and hail was reported locally. In the rear of this depression a bright sunny day was experienced on the 12th and temperature fell somewhat. From then until the 16th depressions moved eastwards to the north of the British Isles and weather was unsettled with rain locally and SW.-W. winds. Temperature continued to fall and hail was reported from many places on the 16th and snow on the Scottish hills on the 17th. On the 17th and 18th a ridge of high pressure between two depressions passed across the country and mainly fair weather (except in the north) prevailed on the 17th and also in the eastern districts on the 18th. On the 18th and 19th the winds backed to S. and rain set in again, mainly moderate but very heavy locally, 3.86 in. were recorded at Fofanny (Co. Down) on the 18th. From the 20th to 25th pressure

was high to the north of the British Isles, while a depression over the Bay of Biscay drifted to the North Sea. Mainly cloudy unsettled conditions prevailed during this time but there was some heavy rain in north England and south Scotland on the 22nd and much mist or fog on the 23rd and 24th. On the 25th and 26th the high pressure to the north-east spread more over the British Isles giving mainly fair sunny weather on those days. But with the onset of the cold northerly winds temperature fell considerably and stormy wintry weather was experienced from the 26th to 28th, while the complex low pressure area over the North Sea grew deeper. Strong winds or gales were recorded from most parts of the coasts. Thunderstorms were widespread on the 26th to 28th, and sleet, snow and hail were recorded, the snow was heavy in the north and midlands, and in scattered showers reached as far south as Hampstead. Maximum temperatures did not exceed 40° F. at Marchmont and Oban on the 27th and Gorleston on the 28th, while a minimum of 17° F. on the ground was recorded at Rhayader on the 28th. On the 29th and 30th the depression moved away first southwards, then north-eastwards, and conditions became milder and calmer, though still unsettled until the 31st. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	42	—44	Liverpool	79	— 7
Aberdeen	66	—29	Ross-on-Wye	86	— 6
Dublin	78	—26	Falmouth	89	—27
Birt Castle	74	—24	Gorleston	100	— 9
Valentia	83	—18	Kew	108	+16

The special message from Brazil states that the rainfall distribution was irregular over the whole country with averages 0.20 in., 0.59 in. above normal in the northern and southern regions respectively and equal to normal in the central regions. Four anticyclones passed across the country. The coffee, cocoa and mattee crops are in generally good condition. At Rio de Janeiro pressure was 0.8 mb. above normal and temperature equal to normal.

Miscellaneous notes on weather abroad culled from various sources. Storms occurred generally over the Ardeches, the Gard and the Vaucluse departments in southern France about the 9th followed by floods, and much damage and some loss of life was caused by a storm in Belgium on the 11th. An unusually early cold spell occurred in Russia during the first part of the month, damaging the crops. A foot of snow had fallen on the Swiss mountains down to the 4,500 ft. level by the 19th, and the higher passes were closed to vehicles. Floods occurred at Millau

(south France) and in the low-lying parts of Saint Affrique on the 23rd, and heavy rains caused floods on the 24th at Renteria between San Sebastian and the frontier, several people being drowned. Widespread damage was caused by a storm on the Belgian coast on the 26th. A waterspout which struck the island of Hvar, off the Dalmatian coast, completely wrecked the three villages of Dubavica, Milna and Velo Grabiji. Snow fell in north Italy at the end of the month and heavy falls of snow were reported about the same time in many parts of France, including the Vosges and the Alps. (*The Times*, October 10th-30th, and *Yorkshire Post*, October 26th.)

A severe storm occurred off Singapore on the 22nd during which a steamer foundered. (*The Times*, October 25th.)

The disastrous drought which extends throughout South Africa, except for a narrow belt round the coast, continued during October. It is estimated that 10,000,000 sheep have been lost. Kenya has also suffered from drought, conditions being most severe in the district south-east of Lake Rudolf. (*The Times*, October 19th-November 3rd.)

Snow began to fall heavily in central and eastern Canada on the 24th, and on the 25th, what was reported as the earliest and worst October blizzard on record was experienced. Heavy snow and gales caused much damage in the States of Vermont, New York, Minnesota and Illinois on the same day. A storm lasting 72 hours and accompanied by heavy rain stripped 150,000 barrels of apples from the trees in Annapolis Valley, Nova Scotia. A hurricane passed close to the west end of Jamaica on the 2nd and 3rd and there were floods with heavy rain and high wind elsewhere on the island, much damage being done to the banana crop. On the 4th a hurricane accompanied by heavy rain passed across Cuba and many small craft were sunk in Havana harbour. A storm passed over the southern part of Jamaica on the 28th, reaching hurricane force when it struck the west end of the island during the night. Twenty people were killed, and it is estimated that 15,000,000 banana trees were destroyed. In the United States temperature was generally above normal in the Mountain Region and along the Pacific Coast, below normal rising to above normal along the Atlantic coast and in the Gulf States, and variable in the middle States. Rainfall was on the whole below normal except in Florida. (*The Times*, October 6th-November 2nd, and *Washington, D.C., U.S. Dept. Agric. Weekly Weather and Crop Bulletin*.)

General Rainfall for October, 1933

England and Wales	...	103	} per cent of the average 1881-1915.
Scotland	...	107	
Ireland	...	83	
British Isles	...	<u>100</u>	

Rainfall: October, 1933: England and Wales.

Co.	STATION	In.	Per- cent. of Av.	Co.	STATION	In.	Per- cent. of Av.
<i>Lond.</i>	Camden Square	1.58	60	<i>Leis.</i>	Thornton Reservoir ...	2.89	103
<i>Kent.</i>	Tenterden, Ashenden...	1.52	44	"	Belvoir Castle.....	2.74	101
"	Folkestone, Boro. San.	2.14	...	<i>Leis.</i>	Ridlington	2.53	90
"	St. Peter's, Hildersham	...	...	"	Boston, Skirbeck	3.18	116
"	Eden b'dg., Falconhurst	2.01	56	"	Cranwell Aerodrome ...	2.59	90
"	Sevenoaks, Speldhurst	2.01	...	"	Skegness, Marine Gdns	2.73	100
<i>Sus.</i>	Compton, Compton Ho.	2.23	49	"	Louth, Westgate	3.08	95
"	Patching Farm	1.79	45	"	Brigg, Wrawly St. ...	5.14	...
"	Eastbourne, Wil. Sq.	2.80	67	<i>Notts.</i>	Worksop, Hodsock	4.32	164
"	Heathfield, Barklye ...	2.04	49	<i>Derby.</i>	Derby, L. M. & S. Rly.	3.91	150
<i>Hants.</i>	Ventnor, Roy. Nat. Hos.	2.64	67	"	Buxton, Terr. Slopes	7.00	142
"	Fordingbridge, Oaklands	1.83	44	<i>Ches.</i>	Runcorn, Weston Pt. ...	4.00	116
"	Ovington Rectory	2.81	69	<i>Lancs.</i>	Manchester, Whit Pk.	4.58	139
"	Sherborne St. John ...	1.81	51	"	Stonyhurst College ...	5.25	117
<i>Herts.</i>	Welwyn Garden City...	1.43	...	"	Southport, Hesketh Pk	3.57	112
<i>Bucks.</i>	Slough, Upton	1.59	57	"	Lancaster, Greg Obsy.	5.04	122
"	H. Wycombe, Flackwell	1.73	...	<i>Yorks.</i>	Wath-upon-Deane	4.63	167
<i>Oxf.</i>	Oxford, Mag. College...	1.50	54	"	Wakefield, Clarence Pk.	4.10	143
<i>Nor.</i>	Pitsford, Sedgebrook...	1.70	63	"	Oughtershaw Hall.....	5.36	...
"	Oundle.....	1.80	...	"	Wetherby, Ribston H.	3.88	129
<i>Beds.</i>	Woburn, Crawley Mill	1.44	54	"	Hull, Pearson Park ...	4.31	161
<i>Cam.</i>	Cambridge, Bot. Gdns.	1.52	64	"	Holme-on-Spalding ...	5.56	...
<i>Essex.</i>	Chelmsford, County Lab	1.53	62	"	West Witten, Ivy Ho.	3.06	82
"	Lexden Hill House ...	1.88	...	"	Felixkirk, Mt. St. John	4.29	149
<i>Suff.</i>	Haughley House.....	1.89	...	"	York, Museum Gdns.	3.33	124
"	Campsea Ashe.....	2.05	78	"	Pickering, Hungate ...	4.88	160
"	Lowestoft Sec. School	3.58	128	"	Scarborough	4.64	148
"	Bury St.-Ed. Westley H.	2.45	90	"	Middlesbrough	3.88	129
<i>Norf.</i>	Wells, Holkham Hall	3.74	133	"	Baldersdale, Hury Res.	...	...
<i>Wilts.</i>	Devizes, Highclere.....	2.42	78	<i>Durh.</i>	Ushaw College	3.76	109
"	Calne, Castleway	2.41	75	<i>Nor.</i>	Newcastle, Town Moor	3.47	108
<i>Dor.</i>	Evershot, Melbury Ho.	3.02	65	"	Bellingham, Highgreen	3.44	88
"	Weymouth, Westham.	1.81	50	"	Lilburn Tower Gdns...	4.51	122
"	Shaftesbury, Abbey Ho.	2.13	55	<i>Cumb.</i>	Carlisle, Scaleby Hall	2.40	72
<i>Devon.</i>	Plymouth, The Hoe ...	3.49	88	"	Borrowdale, Seathwaite	9.00	79
"	Holne, Church Pk. Cott.	7.23	110	"	Borrowdale, Moraine ..	8.19	...
"	Teignmouth, Den Gdns.	2.31	60	"	Keswick, High Hill...	5.76	103
"	Cullompton.....	3.18	77	<i>West.</i>	Appleby, Castle Bank	5.29	152
"	Sidmouth, Sidmount...	2.37	64	<i>Mon.</i>	Abergavenny, Larch ...	5.71	136
"	Barnstaple, N. Dev. Ath	4.88	107	<i>Glam.</i>	Ystalyfera, Wern Ho.	11.88	172
"	Dartm'r, Cranmere Pool	9.00	...	"	Cardiff, Ely P. Stn. ...	4.92	102
"	Okehampton, Uplands	6.41	106	"	Treherbert, Tynywaun	11.34	...
<i>Corn.</i>	Redruth, Trewirgie ...	8.64	165	<i>Carm.</i>	Carmarthen Friary ...	8.25	144
"	Penzance, Morrab Gdn.	6.53	140	<i>Pemb.</i>	Haverfordwest, School	8.16	151
"	St. Austell, Trevarna...	7.05	134	<i>Card.</i>	Aberystwyth	5.39	...
<i>Soms.</i>	Chewton Mendip	3.27	68	<i>Rad.</i>	Birm W.W. Tynywydd	7.69	116
"	Long Ashton	2.84	75	<i>Mont.</i>	Lake Vyrnwy	6.30	111
"	Street, Millfield.....	2.76	85	<i>Flint.</i>	Sealand Aerodrome ...	3.46	115
<i>Glos.</i>	Blockley	2.52	...	<i>Mer.</i>	Dolgelley, Bontddu ...	8.19	134
"	Cirencester, Gwynfa ...	2.99	90	<i>Carm.</i>	Llandudno	3.61	100
<i>Here.</i>	Ross, Birchlea.....	3.73	113	"	Snowdon, L. Llydaw	9.15	87
<i>Salop.</i>	Church Stretton.....	5.18	143	<i>Ang.</i>	Holyhead, Salt Island	3.48	87
"	Shifnal, Hatton Grange	4.71	166	"	Lligwy.....	4.24	...
<i>Staffs.</i>	Market Drayt'n, Old Sp.	4.82	157	<i>Isle of Man</i>			
<i>Worc.</i>	Ombersley, Holt Lock	4.03	151	"	Douglas, Boro' Cem.	5.39	117
<i>War.</i>	Alcester, Ragley Hall..	3.64	133	<i>Guernsey</i>			
"	Birmingham, Edgbaston	5.00	180	"	St. Peter P't. Grange Rd	2.83	63

Rainfall: October, 1933: Scotland and Ireland.

Co.	STATION	In.	Per- cent of Av.	Co.	STATION	In.	Per- cent of Av.
<i>Wig.</i>	Pt. William, Monreith	2.55	64	<i>Suth.</i>	Melvich	3.87	105
"	New Luce School	4.16	89	"	Loch More, Achfary	9.88	127
<i>Kirk.</i>	Dalry, Glendarroch	3.69	70	<i>Caith.</i>	Wick	3.89	133
"	Carsphairn, Shiel	5.91	83	<i>Ork.</i>	Deerness	2.63	69
<i>Dumf.</i>	Dumfries, Crichton, R.I.	2.50	94	<i>Shet.</i>	Lerwick	4.07	103
"	Eskdalemuir Obs.	3.70	69	<i>Cork.</i>	Caheragh Rectory	2.19	...
<i>Roxb.</i>	Braxholm	4.19	129	"	Dummanway Rectory	2.94	49
<i>Selk.</i>	Ettrick Manse	4.25	77	"	Cork, University Coll.	2.09	54
<i>Peeb.</i>	West Linton	3.12	...	"	Ballinacura	2.41	59
<i>Berw.</i>	Marchmont House	3.63	95	<i>Kerry.</i>	Valentia Obsy	3.21	58
<i>E. Lot.</i>	North Berwick Res.	2.38	80	"	Gearhaneeen	5.80	63
<i>Midl.</i>	Edinburgh, Roy. Obs.	2.25	82	"	Darrynane Abbey	3.35	67
<i>Lan.</i>	Auchtyfardle	3.13	...	<i>Wat.</i>	Waterford, Gortmore	3.96	101
<i>Ayr.</i>	Kilmarnock, Kay Pk.	2.89	...	<i>Tip.</i>	Nenagh, Cas. Lough	2.21	65
"	Girvan, Pinmore	4.20	84	"	Roscrea, Timoney Park	2.15	...
<i>Renf.</i>	Glasgow, Queen's Pk.	3.04	93	"	Cashel, Ballinamona	2.12	59
"	Greenock, Prospect H.	3.18	59	<i>Lim.</i>	Foynes, Coolnanes	2.18	59
<i>Bute.</i>	Rothsay, Ardenraig	3.93	...	"	Castleconnell Rec.	2.04	...
"	Dougarie Lodge	3.65	...	<i>Clare.</i>	Inagh, Mount Callan	3.49	...
<i>Arg.</i>	Ardgour House	10.37	...	"	Broadford, Hurdle's n.	2.03	...
"	Glen Etive	...	...	<i>Wexf.</i>	Gorey, Courtown Ho.	3.93	111
"	Oban	3.49	76	<i>Kilk.</i>	Kilkenny Castle	...	...
"	Poltalloch	...	...	<i>Wick.</i>	Rathnew, Clonmannon	3.36	...
"	Inveraray Castle	6.89	98	<i>Carl.</i>	Hacketstown Rectory	4.84	127
"	Islay, Eallabus	3.90	82	<i>Leix.</i>	Blandsfort House	2.70	77
"	Mull, Benmore	13.30	...	"	Mountmellick	2.93	...
"	Tiree	5.93	130	<i>Offaly.</i>	Birr Castle	2.11	73
<i>Kinr.</i>	Loch Leven Sluice	2.81	82	<i>Dublin.</i>	Dublin, FitzWm. Sq.	2.02	75
<i>Perth.</i>	Loch Dhu	5.40	76	"	Balbriggan, Ardgillan	3.12	116
"	Balquhiddy, Stronvar	5.52	...	<i>Meath.</i>	Beauparc, St. Cloud	3.45	...
"	Crieff, Strathearn Hyd.	3.66	93	"	Kells, Headfort	2.70	81
"	Blair Castle Gardens	3.78	122	<i>W. M.</i>	Moate, Coolatore	2.73	...
<i>Angus.</i>	Kettins School	3.41	108	"	Mullingar, Belvedere	2.75	88
"	Pearsie House	4.38	...	<i>Long.</i>	Castle Forbes Gdns.	2.26	69
"	Montrose, Sunnyside	3.52	127	<i>Gal.</i>	Galway, Grammar Sch.	1.85	...
<i>Aber.</i>	Braemar, Bank	6.46	172	"	Ballynahinch Castle	3.76	63
"	Logie Coldstone Sch.	6.12	189	"	Ahascragh, Clonbrock	3.16	86
"	Aberdeen, King's Coll.	4.72	157	<i>Mayo.</i>	Blacksod Point	4.50	90
"	Fyvie Castle	6.45	168	"	Mallaranny	5.07	...
<i>Moray.</i>	Gordon Castle	6.38	202	"	Westport House	4.13	92
"	Grantown-on-Spey	5.46	184	"	Delphi Lodge	9.98	105
<i>Nairn.</i>	Nairn	2.96	126	<i>Sligo.</i>	Markree Obsy	3.35	82
<i>Inv's.</i>	Ben Alder Lodge	7.09	...	<i>Ferm.</i>	Enniskillen, Portora	2.47	...
"	Kingussie, The Birches	5.42	...	<i>Arm.</i>	Armagh Obsy	2.90	73
"	Inverness, Culduthel R.	3.88	...	<i>Down.</i>	Fofanny Reservoir	7.32	...
"	Loch Quoich, Loan	15.00	...	"	Seaforde	3.74	105
"	Glenquoich	...	...	"	Donaghadee, C. Stn.	2.15	74
"	Arisaig, Faire-na-Sguir	5.62	...	"	Banbridge, Milltown	1.91	69
"	Fort William, Glasdrum	9.59	...	<i>Antr.</i>	Belfast, Cavehill Rd.	3.07	...
"	Skye, Dunvegan	5.17	...	"	Aldergrove Aerodrome	2.34	78
"	Barra, Skallary	5.09	...	"	Ballymena, Harryville	4.29	116
<i>R & C.</i>	Alness, Ardross Castle	5.34	139	<i>Lon.</i>	Garvagh, Moneydig	4.27	...
"	Ullapool	4.90	101	"	Londonderry, Creggan	4.30	117
"	Achnashellach	7.93	99	<i>Tyr.</i>	Omagh, Edenfel.	3.03	82
"	Stornoway	4.80	93	<i>Don.</i>	Malin Head	3.77	...
<i>Suth.</i>	Laig	4.59	123	"	Milford, The Manse	5.34	184
"	Tongue	5.23	125	"	Killybegs, Rockmount.	3.41	...

Climatological Table for the British Empire, May, 1933

STATIONS	PRESSURE			TEMPERATURE							PRECIPITATION				BRIGHT SUNSHINE							
	Mean of Day M.S.L.	Diff. from Normal	mb.	Absolute		Mean Values					Mean Cloud Amt	Diff. from Normal	Days	Hours per day		Per- cent- age of day possible						
				Max.	° F.	Min.	° F.	Max.	° F.	Mth.							° F.	1/2 min.	Diff. from Normal	° F.	Wet Bulb	° F.
London, Kew Obsv.	1015.1	-0.8	77	39	64.2	47.5	55.9	48.8	+2.5	81	6.6	1.83	+0.11	14	5.6	36						
Gilwiltar	1015.8	-0.3	87	52	78.0	59.1	68.5	58.6	+3.0	82	4.1	0.11	+1.46	2	..	..				
Malta	1015.0	+0.5	92	55	69.5	59.1	64.3	58.3	+1.6	71	5.0	0.48	+0.02	4	9.7	70						
St. Helena	1014.3	+0.7	70	58	66.7	59.6	63.1	60.5	0.0	93	7.9	0.82	..	13	..	..				
Freetown, Sierra Leone	1013.1	+1.9	93	70	89.5	76.6	82.1	77.4	+1.4	85	7.7	6.61	-7.82	13	..	..				
Lagos, Nigeria	1012.3	+1.7	90	71	87.6	76.3	82.1	77.4	+1.4	85	7.7	6.61	-7.82	13	6.8	55						
Kaduna, Nigeria	1011.9	+0.8	100	68	90.5	72.6	81.5	77.4	+1.4	85	7.7	6.61	-7.82	13	7.3	58						
Zomba, Nyasaland	1019.1	+4.0	89	50	78.2	55.5	66.9	58.4	+1.1	59	4.5	0.09	-0.95	2	..	..				
Salisbury, Rhodesia	1018.5	+0.1	79	39	74.4	45.9	60.1	52.6	+0.5	49	1.3	0.00	-0.48	0	9.5	84						
Cape Town	1019.6	+1.5	82	39	67.7	49.3	58.5	50.4	+0.4	50.5	8.9	1.96	-1.79	14	..	..				
Johannesburg	1018.7	+0.9	78	25	67.8	48.2	58.0	45.9	+3.6	42	1.2	0.12	-0.64	2	9.6	88						
Mauritius	1015.3	-1.1	83	58	79.7	68.6	73.1	68.6	+0.5	72	6.4	1.17	-1.86	23	8.7	78						
Calcutta, Alipore Obsv.	1005.0	+1.5	100	70	94.1	77.2	85.7	77.9	+0.4	78.7	8.2	4.9	+7.48	11*	..	..				
Bombay	1006.4	+1.0	93	74	91.0	79.6	85.3	78.5	+0.5	77.9	7.6	5.5	+2.85	2	..	..				
Madras	1006.0	+0.6	101	77	94.5	80.3	87.4	82.7	+2.4	79.1	7.0	7.5	+0.07	0*	..	..				
Colombo, Ceylon	1009.1	+0.7	88	72	85.7	75.9	80.8	77.5	+2.0	77.5	8.2	8.5	+20.89	28	4.0	32						
Singapore	1008.6	+0.1	93	73	88.7	75.3	82.0	78.5	+0.0	78.5	7.9	5.1	+6.29	14	6.1	50						
Hongkong	1010.8	+1.7	90	71	84.0	75.1	79.5	74.9	+2.1	74.9	7.5	4.5	+7.56	13	7.0	53						
Sandakan	1009.2	..	93	75	89.1	76.4	82.7	78.1	+0.2	78.1	8.0	5.9	+0.67	7	..	..				
Sydney, N.S.W.	1015.5	-3.1	77	45	67.4	52.2	59.8	54.1	+1.0	54.1	7.3	4.1	+5.89	10	6.7	64						
Melbourne	1016.1	-2.7	70	38	61.1	46.8	53.9	48.8	+0.2	48.8	7.7	7.4	+1.48	12	3.3	33						
Adelaide	1017.3	-3.1	76	43	65.2	50.9	58.1	52.8	+0.2	52.8	7.1	8.3	+5.40	16	3.8	37						
Perth, W. Australia	1016.0	-2.4	87	45	69.2	52.7	60.9	54.2	+0.2	54.2	6.7	6.3	+4.67	16	5.7	55						
Coolgardie	1016.6	-2.8	82	39	68.5	48.2	58.3	50.0	+0.6	50.0	5.3	3.3	+1.78	7	..	..				
Brisbane	1016.9	-1.7	79	46	75.1	55.6	65.3	58.4	+0.7	58.4	6.5	4.1	+0.55	3	7.5	70						
Hobart, Tasmania	1011.9	-3.4	63	37	56.5	44.5	50.5	46.5	+0.0	46.5	7.6	7.3	+1.71	20	3.4	35						
Wellington, N.Z.	1011.7	-3.9	62	37	55.7	45.6	50.7	48.1	+2.1	48.1	7.9	7.0	+5.84	17	3.7	37						
Suva, Fiji	1013.3	+0.6	86	68	81.7	72.0	76.9	73.1	+0.4	73.1	8.5	6.7	+10.50	20	4.1	36						
Apia, Samoa	1011.4	+0.3	88	72	86.2	74.7	80.4	77.4	+2.0	77.4	7.8	5.6	+3.99	20	7.5	65						
Kingston, Jamaica	1012.5	-0.6	91	68	87.7	73.2	80.5	72.4	+0.8	72.4	6.9	2.85	-1.54	7	7.8	60						
Grenada, W.I.	1013.6	-1.3	83	35	66.8	48.0	57.4	50.2	+3.6	68	6.5	1.12	+1.67	10	6.4	44						
Toronto	1012.3	-1.5	84	27	67.0	42.4	54.7	43.7	+2.7	43.7	7.4	5.27	+3.27	9	8.0	52						
Winnipeg	1012.9	-1.0	76	28	56.7	39.9	48.3	43.5	+0.6	43.5	6.9	5.8	+3.51	13	8.5	57						
St. John, N.B.	1012.9	-1.0	76	28	56.7	39.9	48.3	43.5	+0.6	43.5	6.9	5.8	+3.51	13	8.5	57						
Victoria, B.C.	1015.5	-1.2	63	41	58.6	45.1	50.9	47.5	+2.1	47.5	7.5	1.50	+0.37	16	6.8	45						

*For Indian stations a rain day is a day on which 0.1 in. or more rain has fallen.

* For Indian stations a rain day is a day on which 0.1 in. or more rain has fallen.

St. John, N.B.	1012.9	-	1.0	76	63	41	56.7	39.9	48.3	+	0.6	43.5	69	5.8	7.5	1.50	+	0.20	13	8.9	57
Victoria, B.C.	1015.5	-	1.2	63	41	56.6	45.1	50.9	-	2.1	47.6	53	7.5	1.50	+	0.37	16	6.8	45		

* For Indian stations a rain day is a day on which at least one or more rain has fallen.